REMARKS

Claims 1-31 are pending. Claims 15-25 and 31 are withdrawn as drawn to non-elected inventions. Applicants reserve the rights to file one or more continuation applications directed to the non-elected inventions.

Claims 1 and 29 are amended to recite that the proteorhodopsin is detergent-solubilized. Support for the amendment can be found throughout the application, for example, at page 3, line 25.

No new matter is added in any of the amendments. The Examiner is requested to enter the amendments and re-consider the application.

102(a) Rejections

8. Claims 1-4, 8, 9-14, 26, 28 and 29 are rejected under 35 U.S.C. 102(a) as allegedly being anticipated by Dioumaev et al. "Proton Transfers in the photochemical reaction cycles of proteorhodopsin" Biochem., Vol. 41 pp. 5348-5358 (4/2002). The rejection is overcome in parts in view of the claim amendments and traversed in parts.

Dioumaev et al. only disclose the measurements of photocycle kinetics of proteohrodopsin (PR) **using PR membranes encased in polyacrylamide gels or using membrane suspensions**. Claims 1 and 29 as amended, are directed to an optical information carrier comprising a solid material having immobilized proteorhodopsin, wherein the proteohrodopsin is detergent-solubilized and free of membrane. Because Dioumaev et al. do not teach detergent-solubilized PR, the 102(a) rejection of Claims 1 and 29 and their dependent claims 2-4, and 8-10 over Dioumaev et al. should be withdrawn.

Claim 11 is directed to a fraud-proof material comprising at least two solid materials each containing immobilized proteorhodopsin having different maximum absorption wavelengths. Dioumaev et al. do not teach a fraud-proof material comprising at least two solid materials each containing a different immobilized proteorhodopsin. Therefore, the 102(a) rejection of Claim 11 over Dioumaev et al. should be withdrawn.

Claim 12 is directed to an optical information carrier comprising a solid material having immobilized proteorhodopsin, wherein said proteorhodopsin is in a monomer or

an oligomer form. Dioumaev et al. do not teach a monomer or an oligomer form of proteorhodopsin. Therefore, the 102(a) rejection of Claim 12 and its dependent claims 13 and 14 over Dioumaev et al. should be withdrawn.

Claim 26 is directed to a method of optically storing information on a material containing immobilized proteorhodopsin, comprising: (b) exposing a selected portion of the material containing immobilized proteorhodopsin to switch the proteorhodopsin from its basal state to its M-state. Claim 28 is directed a method of producing a three-dimensional optical image for information storage, comprising: (b) exposing selected locations and selected layers of the optical information storage material to switch the proteorhodopsin from its basal state to its M-state. Dioumaev et al. only describe the basic research to examine the physical properties of PR, and do not describe any use of PR in optical applications.

The Examiner states that any exposure including a flood exposure of the entire medium meets the claims as there is no language concerning the size or proportion of the medium bearing information. Applicants respectfully disagree with the Examiner's statement. Claims 26 and 28 recite exposing a selected portion of the medium. Example 9 of the application demonstrates exposing small regions of a PR-containing film to green light from a laser and therefore only writing information in certain areas of the PR-containing optical information carrier.

Therefore, the 102(a) rejection of Claims 26 and 28 over Dioumaev et al. should be withdrawn.

9. Claims 1-4, 8, 9-14, 26, 28 and 29 are rejected under 35 U.S.C. 102(a) as allegedly being anticipated by Friedrich et al. "Proteorhodopsin is a light driven proton pump with variable vectorality" J. Mol. Biol. Vol.. 321 pp. 821-838 (8/2002). The rejection is overcome in parts in view of the claim amendments and traversed in parts.

Although Friedrich et al. disclose the purification of proteorhodopsin (PR), **all of the spectroscopic data cited by the Examiner were obtained using PR reconstituted in phospholipid membrane vesicles**, and not using purified PR. This is evidenced by the following passages of the reference. At page 823, 2nd column, where the results from the visible spectroscopy experiments (Figure 2) are described, the reference (at lines 8-

10) describes that "yielding a Hill coefficient of 0.67 and a pKa value of 7.68 for reconstituted proteorhodopsin (Figure 2, insert)." This is the experiment where the reconstituted PR was embedded in a polyacrylamide gel. Similarly, at page 835, 1st column, 5th paragraph, the reference describes that "Samples for FT-IR spectroscopy with the attenuated total reflection (ATR) technique were prepared by gently reconstituted in PM lipids (3 mg protein per ml solution) on the surface of the internal reflection element (IRE)," which shows that the FTIR experiments were performed with PR reconstituted in a lipid membrane.

Because Friedrich et al. do not teach a solid material having immobilized proteorhodopsin, wherein the proteohrodopsin is detergent-solubilized, the 102(a) rejection of Claims 1 and 29 and their dependent claims 2-4, and 8-10 over Friedrich et al. should be withdrawn.

Claim 11 is directed to a fraud-proof material comprising at least two solid materials each containing immobilized proteorhodopsin having different maximum absorption wavelengths. Friedrich et al. do not teach a fraud-proof material comprising at least two solid materials each containing a different immobilized proteorhodopsin. Therefore, the 102(a) rejection of Claim 11 over Friedrich et al. should be withdrawn.

Claim 12 is directed to an optical information carrier comprising a solid material having immobilized proteorhodopsin, wherein said proteorhodopsin is in a monomer or an oligomer form. Friedrich et al. do not teach a solid material comprising a monomer or an oligomer form of proteorhodopsin. Therefore, the 102(a) rejection of Claim 12 and its dependent claims 13 and 14 over Friedrich et al. should be withdrawn.

Friedrich et al. only describe the basic research to examine the physical properties of PR, and do not describe any use of PR in optical applications. The Examiner states that any exposure including a flood exposure of the entire medium meets the present claims. The Examiner's statement is incorrect because the method steps of Claims 26 and 28 recite exposing a selected portion of the medium, which is different from the flood exposure of the entire medium. Therefore, the 102(a) rejection of Claims 26 and 28 over Friedrich et al. should be withdrawn.

103(a) Rejections

10. Claims 1-14 and 26-30 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over either Dioumaev et al., or Friedrich et al., in view of Hampp et al. (U.S. Patent No. 6,274,279). The rejection is overcome in parts in view of the claim amendments and traversed in parts.

As discussed above, Dioumaev et al. or Friedrich et al. do not teach the claimed invention. **The detergent-solubilized PR or the monomer/oligomer form of PR has unexpected advantages over the membrane fragments-containing PR, or phospholipid vesicle-containing PR in that the former does not cause light scattering, thus providing a good signal-to-noise ratio** (see Application at page 3, lines 25-29).

The addition of Hampp et al., which only disclose bacteriorhodopsin (BR), does not cure the deficiency of Dioumaev et al. or Friedrich et al. Hampp et al. use native purple membrane patches, which are micrometer sized patches containing a 2D crystal of lipids and BR proteins. Hampp et al. do not teach or suggest PR.

The disadvantages of BR are described in the application at page 1, lines 19-27: "One of the problems with the BR-based films is that BR forms 0.2-1 μm sized protein-lipid patches. If BR is extracted from these patches to form a monomeric protein, it becomes unstable and is inactivated in a few days. The problem with using these BR patches in optical films is that the patches are approximately the same size as the wavelength of the light used to interface the film. This results in significant light scattering during read and write cycles, thereby increasing noise and degrading the performance of the film. Additionally, the BR patches tend to stick to each other, which result in uneven distribution of the BR protein in the film, and further degrade the performance of BR-based optical films."

The advantages of PR over BR are described in the application at pages 6 and 7. "One advantage of using proteorhodopsin as an optical information carrier is that proteorhodopsin can be functionally expressed in E. coli to produce a large quantity (grams or kilograms) of protein economically and efficiently." "As an optical data storage material, it is desirable to immobilize membrane-free, detergent-solubilized proteorhodopsin to avoid light scattering. Detergent-solubilized proteorhodopsin is

usually in the form of a monomer, and sometimes in the form of an oligomer (dimer, trimer, tetramer, pentamer, or hexamer). Different from bacteriorhodopsin, proteorhodopsin protein is stable in its monomeric or oligomeric state for at least one month at room temperature, or one year at 4°C."

The examiner states in several places in the Office Action that proteorhodopsin is an archeal rhodopsin like bacteriorhodopsin and argues that it would be obvious to one skilled in the art to modify the examples of Hampp by replacing BR with PR. Applicants respectfully submit that PR is not an archeal rhodopsin; proteorhodopsins originate from eubacteria. Archea and eubacteria are very different from each other in composition and properties. The most relevant difference between archea and eubacteria is the membrane lipids composition. Eubacteria have straight-chain diacyl glycerol diester lipids, whereas archea have isoprenoid glycerol diether or diglycerol tetraether lipids. Since both PR and BR are membrane proteins, this is a very important difference, especially because it is known from the structure of BR that lipids have specific binding sites in the trans-membrane part of BR. Absent hindsight construction or reduction to practice, one cannot simply assume that BR is replaceable by PR in optical applications.

In the present application, **Applicants have provided a working example of optical data storage using proteorhodopsin-PVA film** (See application, Example 9).

Because of the unexpected advantages and the reduction to practice of the present invention, Claims 1-14 and 26-30 are not obvious over either Dioumaev et al., or Friedrich et al., in view of Hampp et al.

11. Claims 1-14 and 26-30 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over either Dioumaev et al. or Friedrich et al., in view of Hampp et al., further in view of Wu et al. "Bacteriorhodopsin encapsulated in transparent solgel glass: A new biomaterial", Chem. Mater. Vol. 5 pp. 115-120 (1993).

As discussed above, Claims 1-14 and 26-30 are not obvious over either Dioumaev et al., or Friedrich et al., in view of Hampp et al. Wu et al. only disclose bacteriorhodopsin encapsulated in sol-gel. Wu et al. do not mention proteorhodopsin. Therefore, the addition of Wu et al does not cure the deficiency of other cited references.

12. Claims 1-14 and 26-30 are rejected under 35 U.S.C. 103(a) as being allegedly unpatentable over Hampp et al., in view of either Beja et al. 'Bacterial Rhodopsin: Evidence for a new type of phototropy in the sea', Science 289, pp. 1902-1906 (2000) or Krebs et al., "Detection of fast light activated H+ release and M intermediate formation from proteorhodopsin", BMC Physiology, Vol. 2 pp. 5-12 (2002).

Baja et al. or Krebs et al. describe a basic research that examines the physical properties of PR. Neither reference has described any use of PR in optical information carrier. As discussed above, absent hindsight construction or reduction to practice, one cannot simply assume that BR is replaceable by PR in optical applications.

Therefore, Claims 1-14 and 26-30 are not obvious over Hampp et al., in view of either Beja et al. or Krebs et al.

13. Claims 1-14 and 26-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hampp et al. in view of either Beja et al. or Krebs et al., further in view of Wu et al.

For the same reasons as discussed above in Sections 12 and 13, Claims 1-14 and 26-30 are not obvious over Hampp et al., in view of either Beja et al. or Krebs et al., further in view of Wu et al.

CONCLUSION

Applicant believes that the application is in good and proper condition for allowance. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is encouraged to call the undersigned at (650) 798-3570.

Respectfully submitted,

Date: November 21, 2006

Viola T. Kung, Ph.D. (Reg. No. 41,131)

HOWREY LLP
2941 Fairview Park Drive
Box 7
Falls Church, VA 22042
Tel: 650-798-3570
Fax: 650-798-3600